



Airborne Internet

## Transformational Aircraft Communication Using a Broadband Mesh Network

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## Airborne Internet Objective

To Enable A Safer, More Secure, More Cost Efficient GAS  
By Eliminating Communications As A Constraint  
On The Economic Viability Of Aviation Related Applications

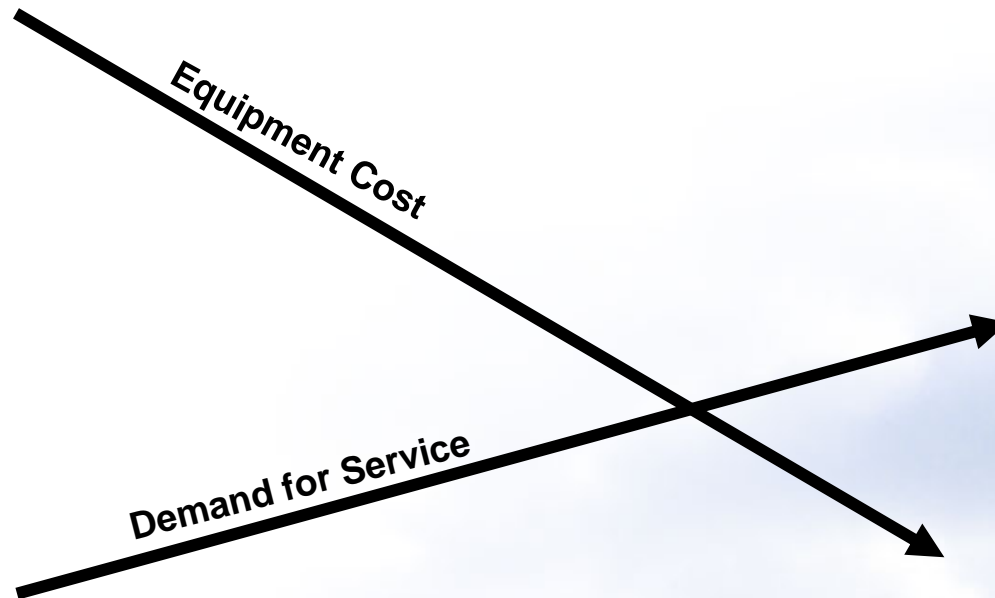
- VERY LOW COST
- VERY HIGH SPEED
- SCALEABLE
- UBIQUITOUS
- SECURE
- OPEN
- EVOLUTIONARY

**WE WANT TO HAVE THE SAME EFFECT ON AVIATION COMMUNICATIONS THAT  
THE TRANSITION FROM COPPER WIRE TO FIBEROPTIC CABLE HAD ON  
TERRESTRIAL COMMUNICATIONS**





## Why Now?



**Airlines: “If it increases costs we don’t want it”**



# Internet to Aircraft

Aircell  
Airshow  
Air TV  
AeroSat  
ARINC  
AT&T Wireless  
Boeing Connexion  
Honeywell  
ICO Global  
In Flight Network  
Inflightonline Inc.  
INMARSAT  
LiveTV  
NewsCorp  
Rockwell Collins  
Teledesic  
Tenzing  
Thompson

**Technical feasibility is not the issue**

**Data can be moved to aircraft**

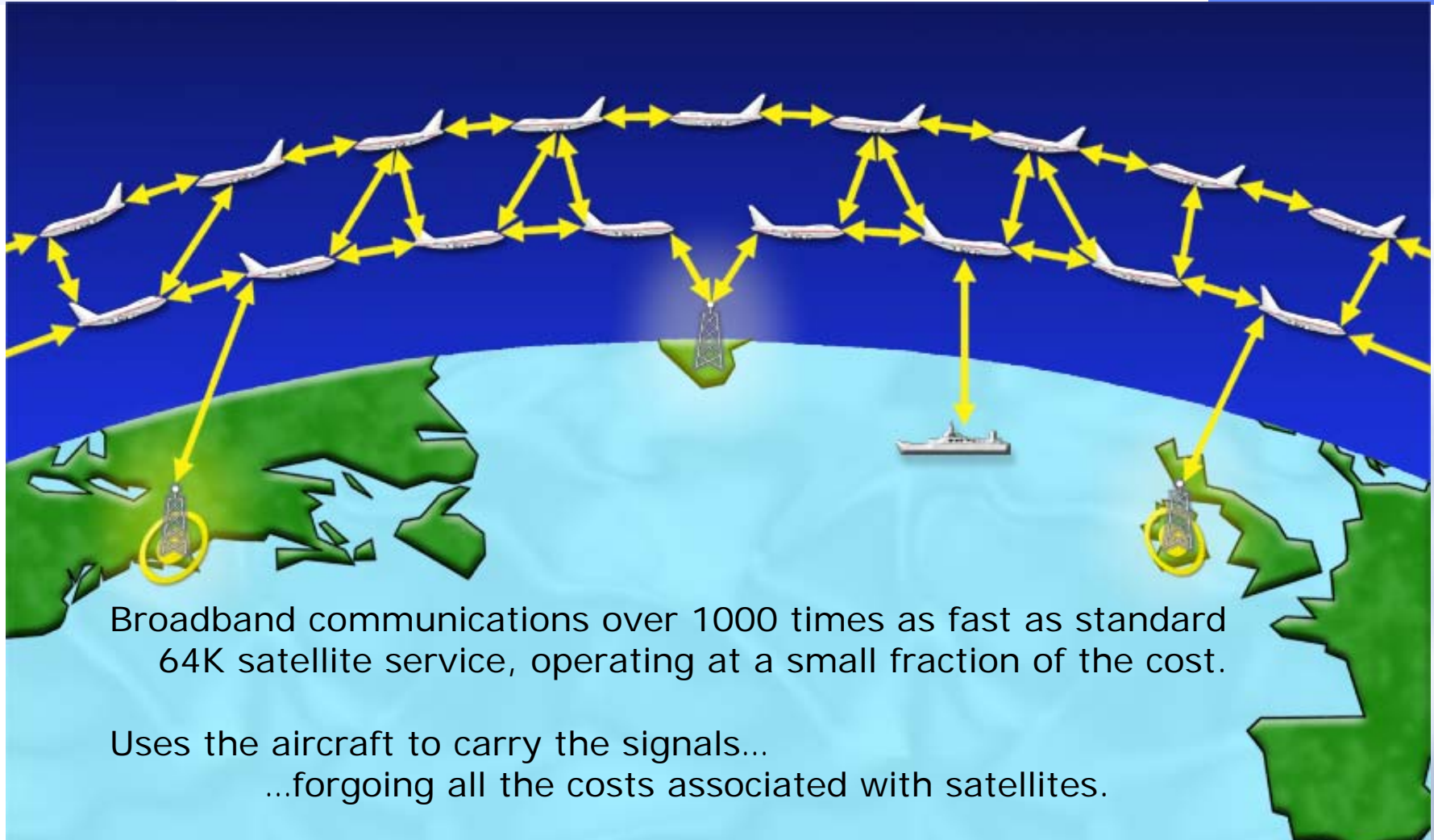
**At high speed  
With ubiquitous coverage  
At low cost**

**But not all three in a single solution**

**Airborne Internet Requires a System of Systems**



## Lowering the Average Cost Increasing the Average Speed

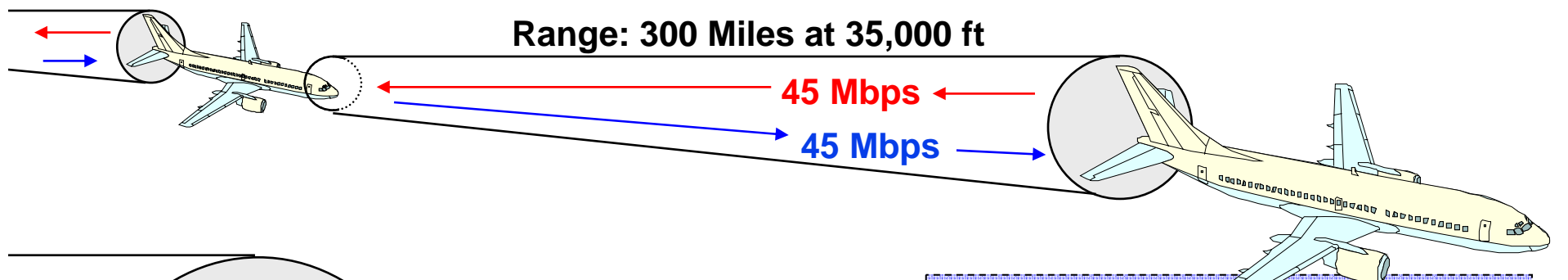


Broadband communications over 1000 times as fast as standard 64K satellite service, operating at a small fraction of the cost.

Uses the aircraft to carry the signals...  
...forgoing all the costs associated with satellites.



# Capabilities and Applications...



## Applications

### Operations and Maintenance:

- Engine Monitoring
- Crew Communications
- Fault Reporting
- Diversion Management

### Cabin Services:

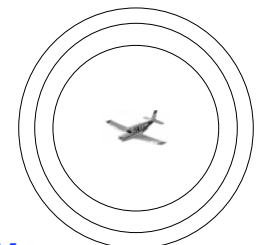
- Internet Access
- Programming Distribution

### Air Traffic Management:

- System Capacity
- Hazardous Weather Avoidance
- Collaborative Decision Making
- Conformance Monitoring

### Safety & Security:

- Transportation Security
- Real Time Black Box Transmission
- Telemedicine

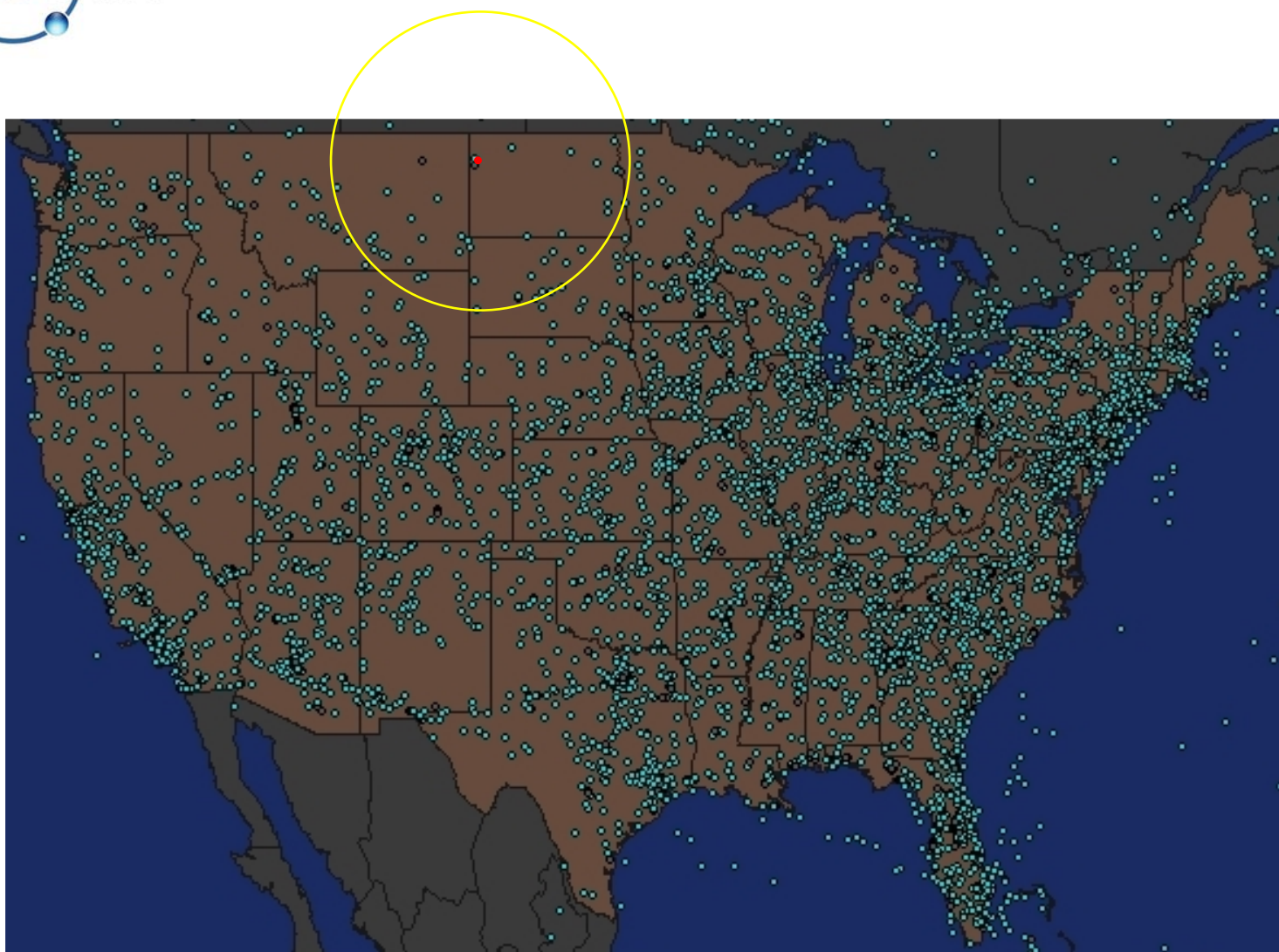


**Decision making requires real-time information...**

**...real-time information requires connectivity.**

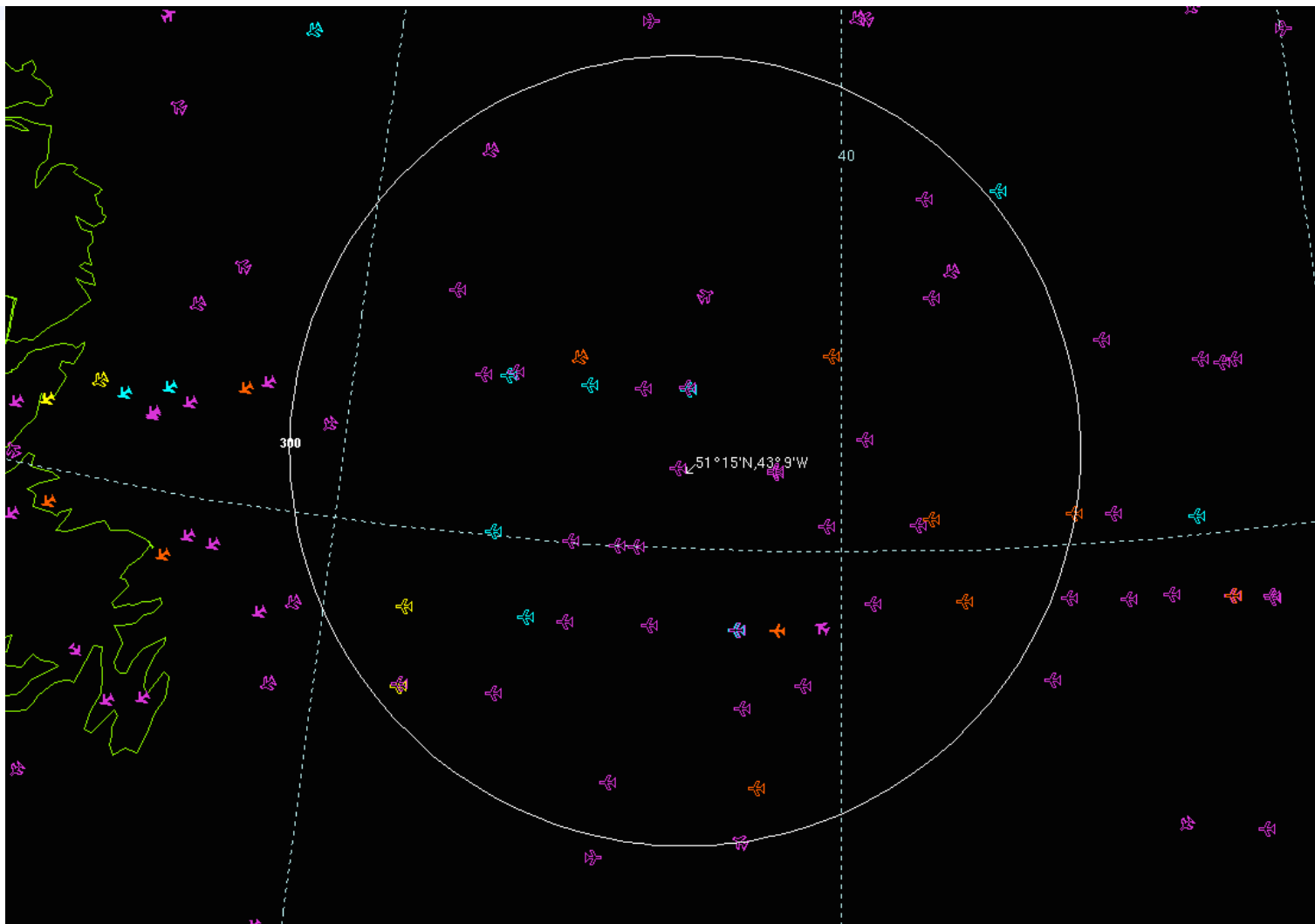


# AeroSat Network Formation over the U.S.





# North Atlantic Traffic Density







# Air to Ground Latency

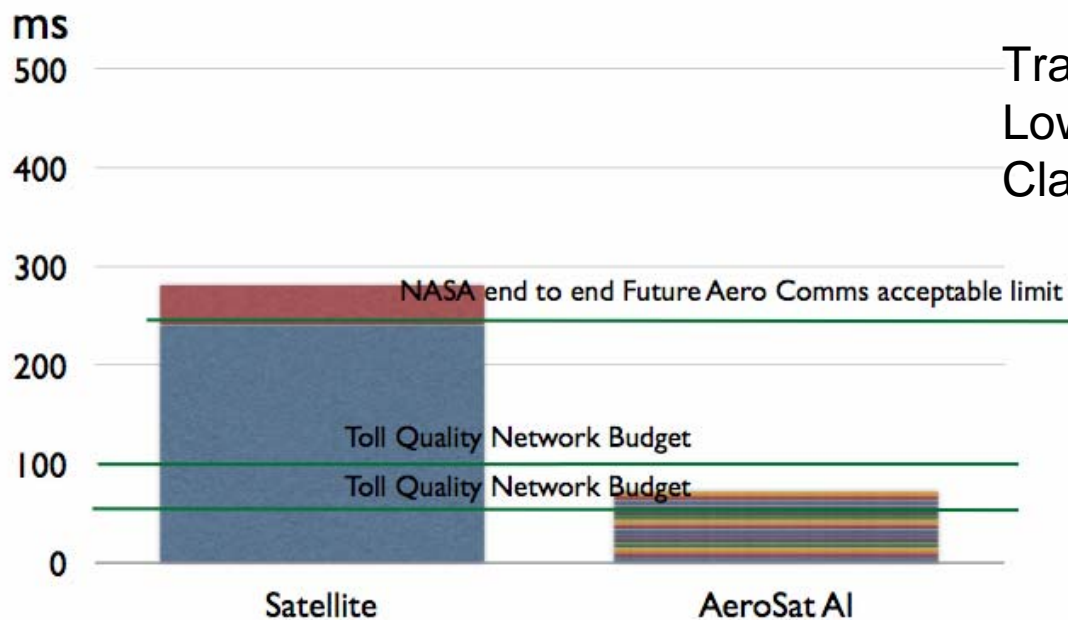


AeroSat AI Latency/node:

1ms RF

4ms Router

5ms Total/node



Traffic Prioritization:

Low Latency Queueing

Class-Based Weighted Fair Queueing

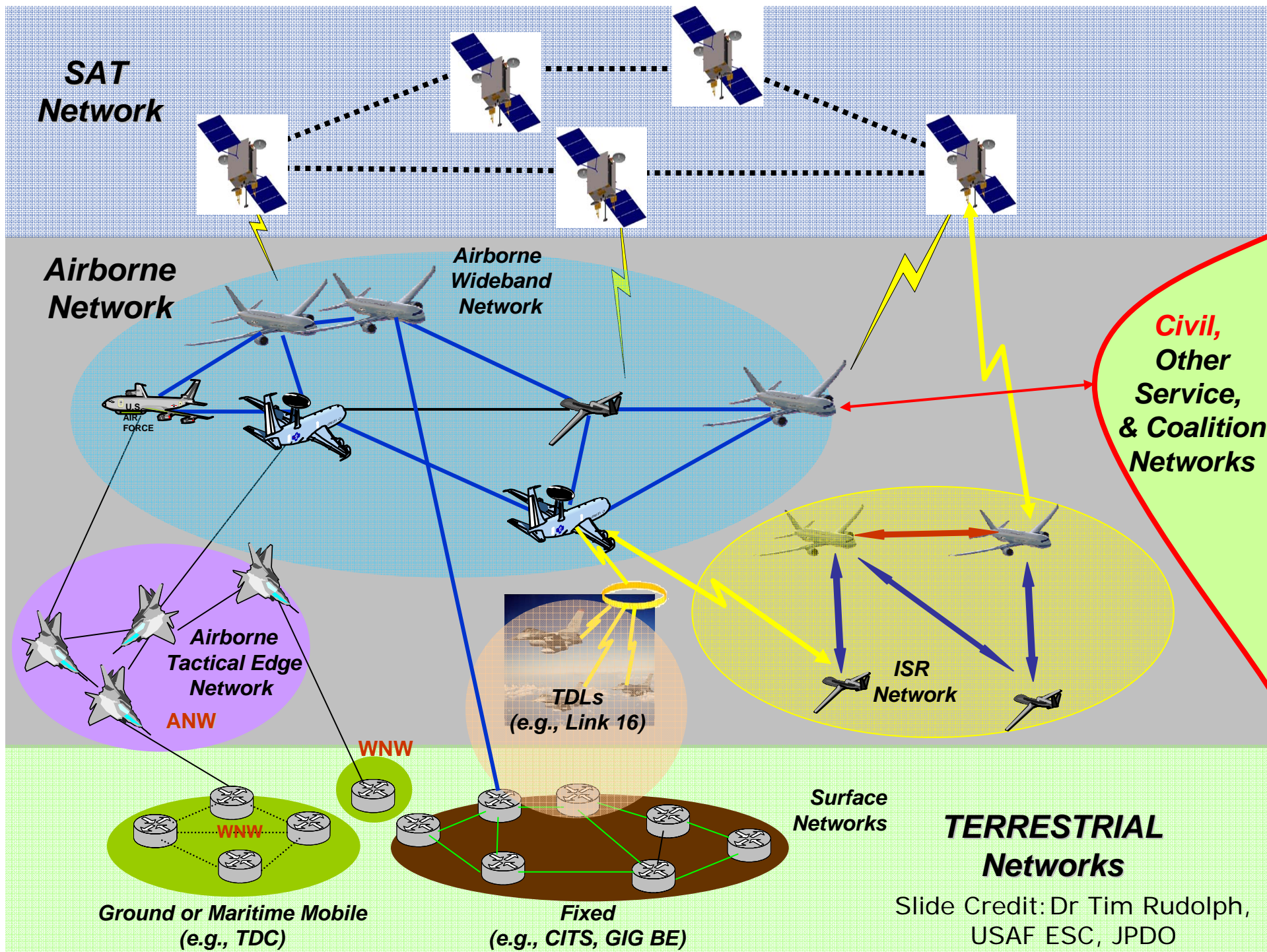
Assumes 15 hops - 4350 miles aircraft to ground

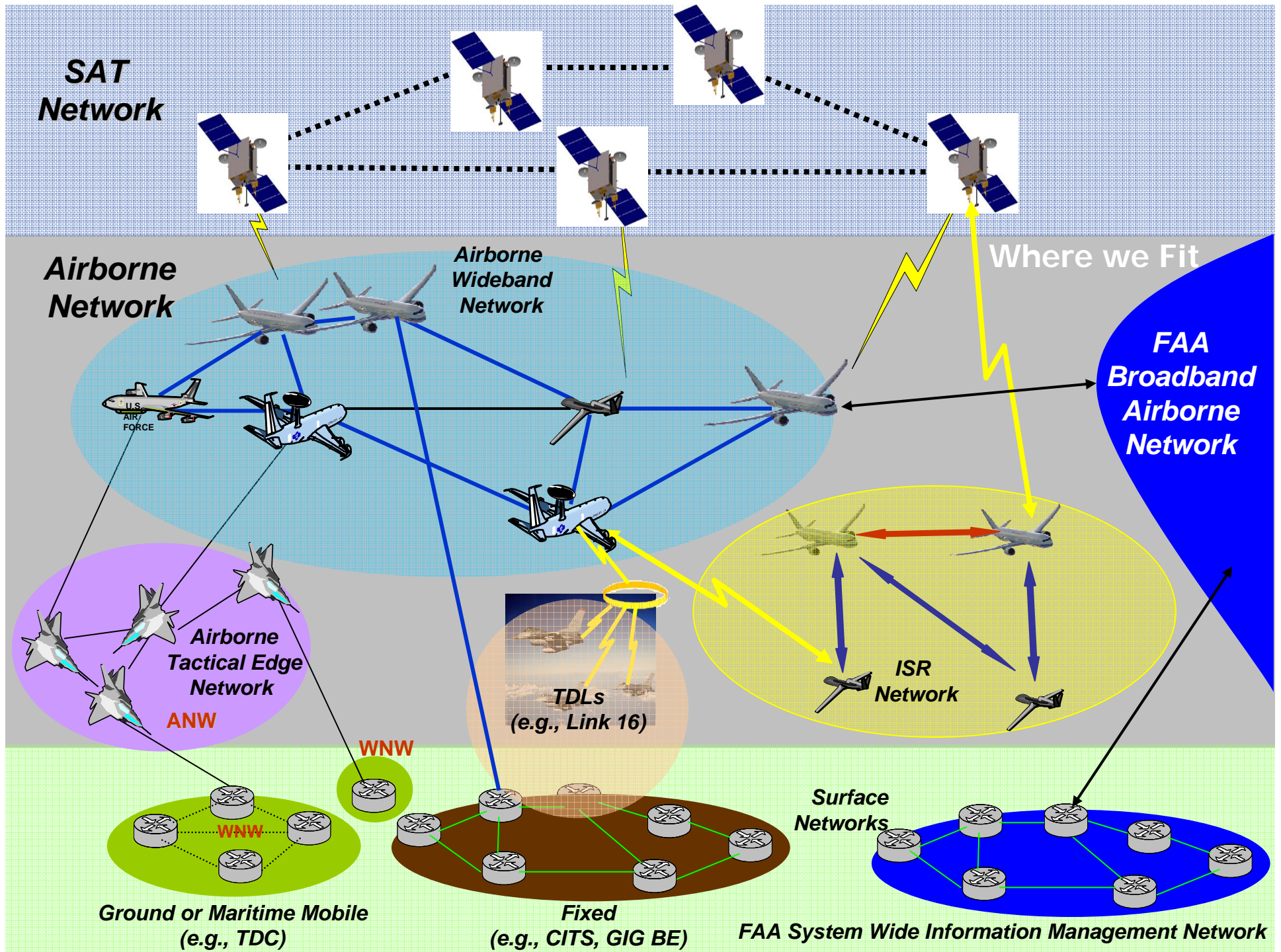


# Network Deployment



Incremental  
Begin with a single base node  
Add airborne connections  
Network expands geographically  
Add a second base node  
Add airborne connections  
Network further expands









## Civil v. Military requirement

Cost - less than \$200K/aircraft

ITAR - U.S. must be willing to sell

International Acceptance - The rest of the world must be willing to buy

Network Connectivity provided to DoD just as commercial telephone, internet, and SATCOM service.

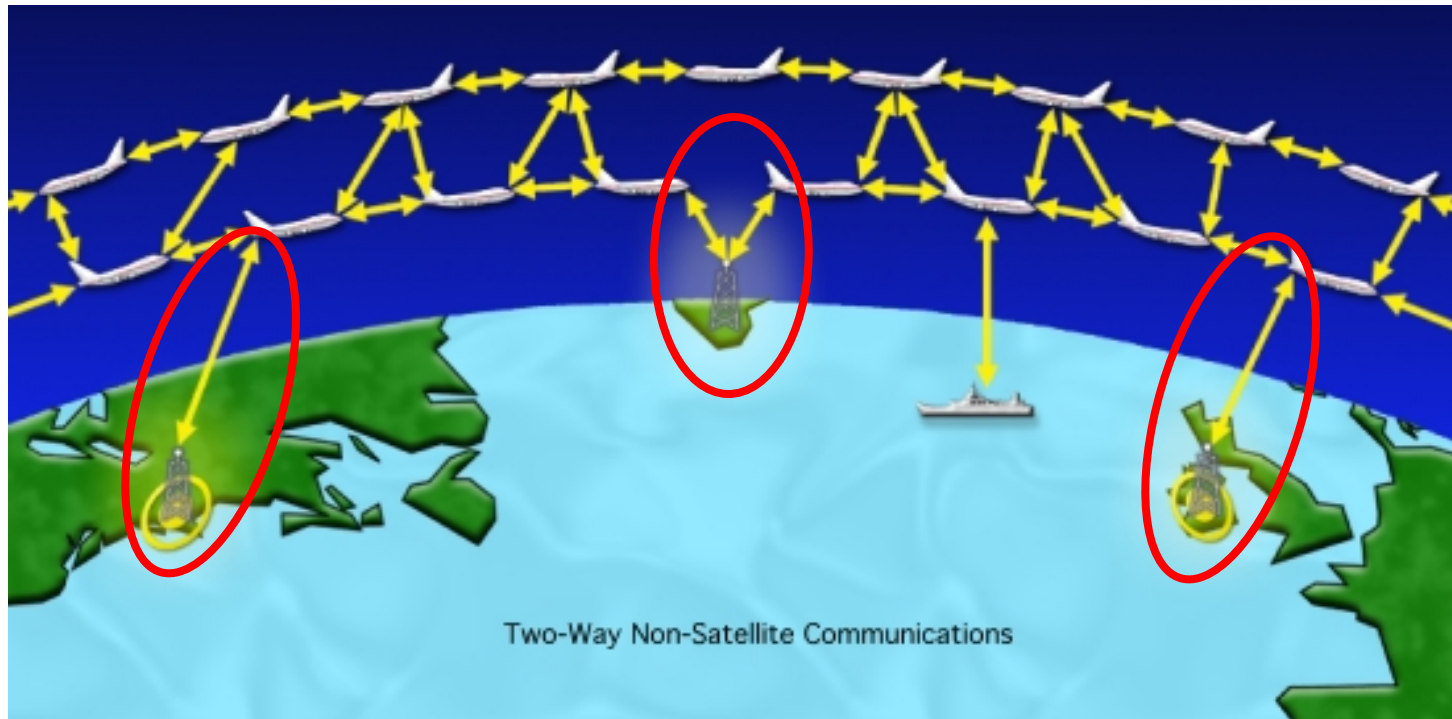




# Broadband Airborne Network Contract

Objectives and Status





Mesh Network tied to Terrestrial Networks via Air<->Ground Links  
This is the Hard Part - Atmosphere, Weather, etc.





## Overview of Demonstration Goals and Objectives



- Demonstration scheduled for mid May
- Demonstrate a high speed full duplex data link from a ground station to an aircraft
  - Up to 45 Mbps out to 150 nautical miles
  - Up to 5 Mbps from 150 nautical miles to 200 miles
- Relay a portion of that data link to a second aircraft
  - Up to 1 Mbps out to 10 nautical miles
  - Up to 100 kbps from 10 nautical miles to 100 nautical miles
- Ground station located on roof of hangar at WJHTC Atlantic City, NJ
- Aircraft flying over the ocean, east/northeast of ground station
- Data link supports Internet Protocol





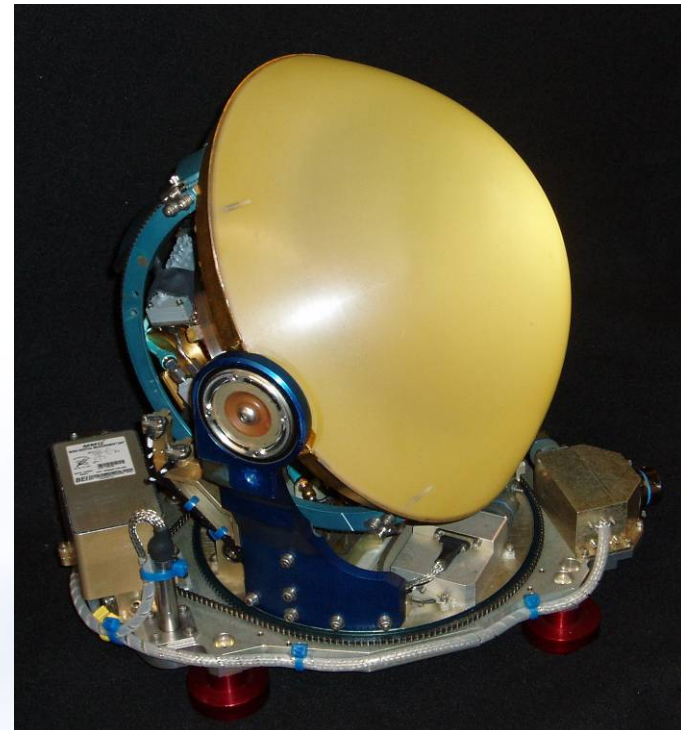
## General Demonstration Constraints *Installation*



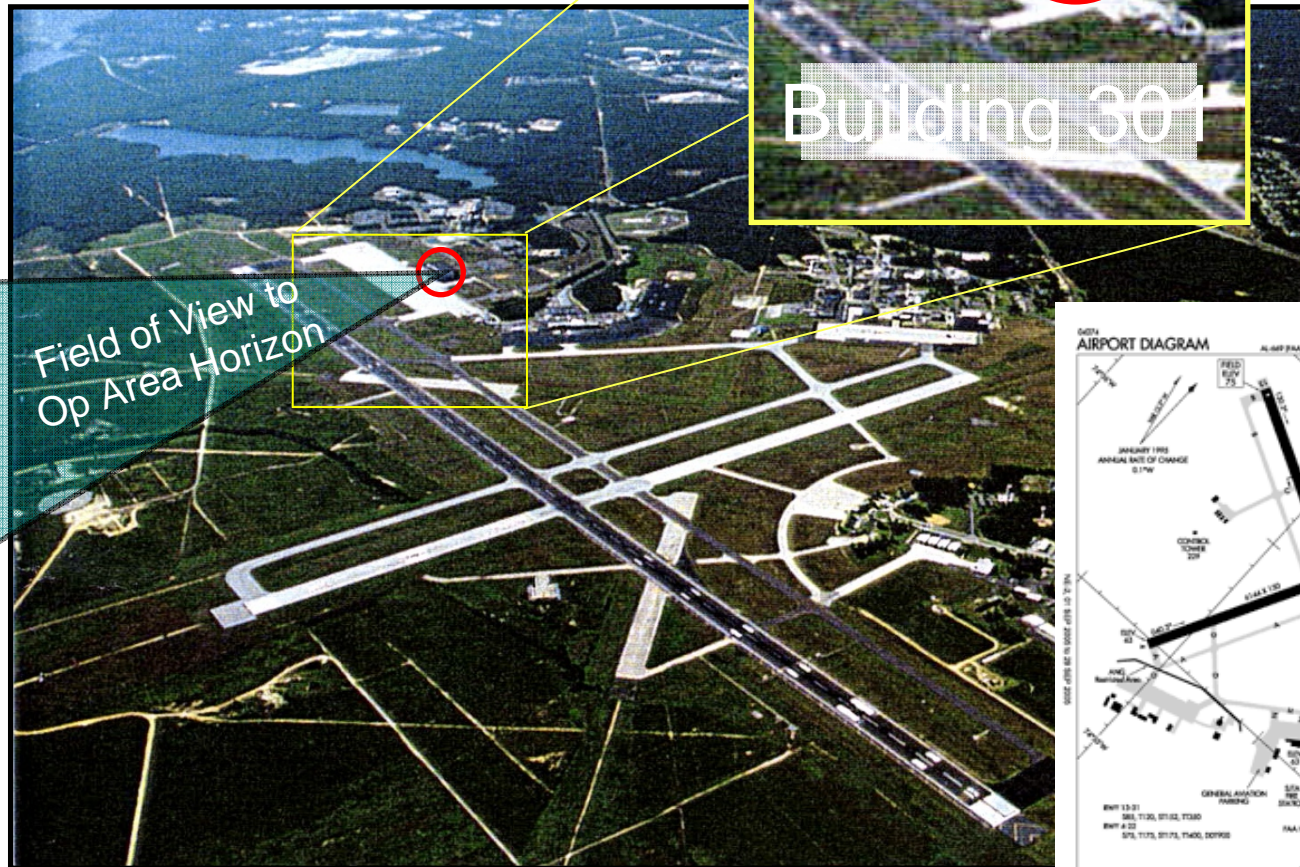
- Global Express 5000 (N47) installed with Air-to-Ground and Air-to-Air data links
  - L-Band Antenna Acquired and Delivered
  - STC in progress for permanently mounted equipment
    - Air-Ground Tail Mounted Equipment
      - Antenna
      - Power amplifier
    - Air-Air Blade Antenna - via existing data package
  - Up/Down Converter unit mounted near rear luggage compartment
  - Remainder of equipment mounted on removable mission rack
- Boeing 727 (N40) installed with Air-to-Air data link
  - 2 small pieces of equipment mounted on one shelf of removable mission rack



- Transmit Gain  
14.0 GHz to 14.5 GHz      32 dBi
- Receive Gain  
11.7 GHz to 12.2 GHz      30 dBi
- Elevation Coverage      0° to 90°
- Azimuth Coverage      360°  
continuous
- Weight      25 lbs.













# Project Overview



Oct 05

Jan 05

Apr 06

Jul 06

Aug 06

